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MORRIS ARBORETUM
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THE MORRIS FOUNDATION

Maintaining THE MORRIS ARBORETUM

OF THE

UNIVERSITY OF PENNSYLVANIA

THE
MORRIS ARBORETUM
OF THE
UNIVERSITY OF PENNSYLVANIA

View in Japanese Garden

The illustration shows the Mansion in the far background, in which are the offices, herbarium and laboratories.

In the foreground at left is an azalea, leafless. Coming into the picture at the left is a part of the top of *Cephalotaxus drupacea,* the Plum Yew, at right of this on the path, *Juniperus excelsa stricta,* and blocking the view in the background is *Juniperus virginiana elegantissima,* gold tip Red Cedar. At the right of the path in the middle of the picture is *Pinus Cembra,* Swiss Stone Pine, with the loosely spreading top of an unnamed pine at the right of the view. The bare top of a tall walnut, now leafless, is seen in right background between the pines just named.

RODNEY H. TRUE

THE TENT CATERPILLAR

In April and May, in eastern Pennsylvania, many wild cherries, apples and other trees of the rose family bear conspicuous silken nests of the Tent Caterpillar. These structures are the work of a community of hairy caterpillars hatched in March or in early April, a few days before the opening of the leaf buds of the infested trees, from eggs laid in the preceding summer.

The eggs are deposited in the form of sleeve-like masses surrounding small twigs. Each sleeve may be one-half to three-fourths of an inch in length and consists of 150-300 eggs, tightly fastened together and to the twig, and whose outer surface is more or less shiny. In winter, when the twigs are bare, these sleeves, or "egg belts," are easily seen, but at other times the foliage is apt to conceal them.

Each caterpillar, when just hatched, is about three-sixteenths of an inch long and nearly black. If the weather be not too continuously cold or wet, the caterpillar becomes full grown in forty days, more or less, having then reached a length of two to two-and-one-half inches. This growth is accompanied by a series of four moults, or sheddings of the outermost covering of the body, previous to the spinning of a cocoon. After each moult there is some change in the coloring, and after the fourth moult there is a white stripe along the middle of the back, and a row of blue and deep velvety black spots each side thereof.

The nest is begun about two days after hatching, if food in the form of young leaves be present. It is increased by the activities of the caterpillars which, pouring forth liquid silk from the floor of their mouths, produce first threads, then layers, of silk. The nest serves as a shelter from unfavorable weather and as a place in which to shed the skins. It increases in size as its occupants become older and larger.

The caterpillars leave the nest from time to time to seek and devour the leaves of the tree or bush in which the nest is placed, but return to it at more or less regular intervals. The feeding periods are usually three per day: at about 7 in the morning, in the early afternoon and, the longest, beginning in the early evening and extending into much of the night. As the leaves near the nest are consumed, the caterpillars naturally must travel longer distances. Their eyes are very small and probably have a low-grade efficiency of vision. To assist itself in finding its way back to the nest, each caterpillar blazes its way by laying down a continuous silken thread on the surface of the branches and twigs over which it travels. Should the foliage of the tree containing the nest be exhausted before the caterpillar's growth has been completed, the insect must seek food on nearby trees, so that the guiding paths then extend down the home trunk to the ground and over it to the next shrub or tree visited. Sometimes a new nest or tent is built on another tree.

Their regular goings-out and comings-back to the nest continue until after the

fourth moult. Then a new impulse appears. The caterpillars forsake their nest and their companions, disperse, wander, no longer leave their silken trails behind them, and each spins a silken cocoon around itself. These cocoons are located in protected situations, as under projecting bits of bark, in little cavities on stone or wooden surfaces, under ledges on buildings. A characteristic of the cocoons of the tent caterpillar, which one can't fail to notice in pulling them down or tearing them open, is the fine sulphur-like dust which is lodged in their walls.

Within the cocoon, after forty-eight hours, the caterpillar moults for the fifth time and now assumes the different form of a *pupa,* a non-feeding and, in this case, a non-moving stage. The sixteen legs of the caterpillar have apparently disappeared, but a closer examination reveals that the six forward ones are still present, but soldered down tightly to the surface of the body. Soldered down, too, are the wings and the feelers of the future moth. The wings previously had not been visible, while the feelers are much enlarged from the almost microscopic organs of the caterpillar.

For about three weeks the pupa remains in the cocoon. Then the final moult occurs, and from the dried pupal "skin" there issues a moth with reddish-brown or buff wings. The moth makes its way out of the cocoon, and scon spreads its wings to an expanse of about one and one-quarter inches. Each fore wing is crossed by two parallel, oblique, whitish lines. The body is hairy and three-quarters of an inch long. The male is a little smaller; his feelers are distinctly feathery, whereas those of the female are less so.

The moths of this species, and of many others, do not feed, their mouth parts never develop sufficiently for this function. Their lives, therefore, are brief, although some are reported to live a week. This portion of their existence is devoted to the production of the next generation. They pair and fertilized eggs are laid by the female two to three days after she has left her cocoon. She places these eggs in the sleeve-like mass described in the second paragraph and the cycle begins again. This occurs in June or July.

This brings us to a remarkable feature of the life history of the Tent Caterpillar. Most insect eggs laid in the first half of summer develop and hatch in a few weeks, with the result that there are at least two broods or generations in twelve months. The eggs of this moth develop, even as far as the caterpillar, during the summer, but ordinarily do not hatch until the following spring. The summer temperatures apparently do not affect them as many other insects are affected, so that there is but one generation of Tent Caterpillars per year. The explanation of this lies, perhaps, in some deep-seated peculiarity in the nature of the species.

The most wide-spread human interest in the Tent Caterpillar is probably that concerning its possible destruction, or at least diminution in numbers. The solution of all such problems must be based on a knowledge of the life-history of the

creature involved. The preceding sketch of the development of the Tent Caterpillar indicates as the most vulnerable points in its career: (1) the living egg-masses on twigs exposed to view during the leafless part of the year; (2) the nests or tents with the young caterpillars within them in the late mornings of April and May; (3) the cocoons with the potential egg-layers in June. These are stages which can be collected with ease and burned, destroying actual or potential individuals *en masse*. Foliage sprayed with arsenicals, of course, kills caterpillars which feed upon it, but this mode of attack is more expensive of both time and material, and the destruction wrought is relatively less.

The Tent Caterpillar, *Malacosoma americana,* is the topic of a number of publications of the United States Department of Agriculture, such as Farmers' Bulletin No. 662, of the extensively illustrated Bulletin No. 120 of the Pennsylvania Department of Agriculture, by Prof. N. F. Davis, of Bucknell University, and of an account by R. E. Snodgrass, in the Annual Report of the Smithsonian Institution for 1922.

MYCORRHIZAE OF TREES AND SHRUBS

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THE symbiotic union of roots of trees and shrubs with certain fungi of the soil results in the root-fungus organs called mycorrhizae. Their wide-spread occurrence in the plant kingdom has led to extensive investigation of the nature of this association. Although the structural relations of plant root and fungus are well known, the physiological action, especially growth influences of one upon the other have been determined with difficulty.

The morphology of fungus-roots or mycorrhizae has been studied in sufficient detail to divide them into two general types: (1) ectotrophic, in which the fungus develops only outside the plant root and between its cells, (2) endotrophic, in which the fungus develops only inside cells of the plant root. Among the trees, beeches, oaks, elms, pines, and spruces possess the ectotrophic form whereas maples, ashes, yellow poplar, and cedar possess the endotrophic form. These forms prevail consistently throughout the native growth range of each species. The lack of intergrading forms indicates that the development of mycorrhizal associations has progressed over a long period of time and reached a condition of relative stability.

It is proven that transplantation to new habitats for the species does not influence the type of mycorrhiza produced, if it is produced at all, and that inter-

mixing of species does not change the fungus-root habit of any plants entering into the mixture. Cultivation practices which place a species under entirely new growth conditions due either to fertilization or soil qualities does not appear to change its mycorrhizal habits. Certain soil fungi producing mycorrhizae may not exist under conditions where trees are planted but there are still sufficient numbers of the closely related fungus species present and capable of producing mycorrhizae. Experimental proof has been obtained to demonstrate that several soil fungi can form mycorrhizae with the same plants. Most shrubs show types of mycorrhiza similar to those of trees and the inter-relations between these, especially when interplanted with trees, has been perplexing. Most soils contain fungi capable of forming mycorrhiza of trees and shrubs even after long periods of cultivation and growth of field crops.

THE FUNGI-FORMING MYCORRHIZAE

The Agaricaceae or gill fungi, Boletaceae or fleshy tube fungi and the Gasteromycetes or puff-ball fungi have been proven mycorrhizal experimentally. Fungi other than these are concerned often in the endotrophic forms of mycorrhizae of some trees, and this association appears consistently for members of the genera Acer, Fraxinus, Liriodendron and Chamaecyparis. Proof of the connection between the endotrophic forms of the fungi concerned has not been obtained, but the morphology of the fungi themselves within the root tissues has been sufficient to establish that certain Ascomycetes or cup fungi and Phycomycetes or water molds are concerned. It appears that nothing other than isolation and experimental proof can make certain regarding the species of fungus or the type of mycorrhiza to be expected even when most of the forms existing within a given area seem to hold constant regardless of the intermingling groups and the treatment given the soil. Fertilization was at one time thought to be responsible for changes in the root habits of many trees through action on the soil fungi which form mycorrhizae, but under controlled conditions it has been found that nutrition was not responsible for any change in form of mycorrhiza morphologically. However, modification of the root habit in such manner that depth of growth is changed may be responsible for certain increases or decreases in amount of mycorrhizae produced. and the relative activity of various species of fungi.

THE HOST PLANTS

Although a small proportion of the trees and shrubs known throughout the world have been reported mycorrhizal in the literature, there appear few exceptions wherever critical examinations were made. Future investigations will reveal that most of them are mycorrhizal. The species represented are found in almost every family and genus. Up to the present time 178 Gymnosperms and 997 Angiosperms have been reported, and of these 44 Gymnosperms and 74 Angiosperms are represented by living specimens in Morris Arboretum are included.

RELATIONS OF MYCORRHIZAL FUNGI TO ROOT TISSUES

The intimate connection between mycorrhizal fungi and the external tissues of roots which they attack have been studied since 1829. Actual evidence that fungus threads can live in contact with the nuclei of the cells of a root has been obtained, and in many cases secondary development of the fungus after apparent absorption of the original growth of hyphae following digestion indicates that the higher plant is able to weaken the attack of the fungus with regularity. Among the ectotrophic forms the fungus is never overcome by its host. Here the existence of the two unlike organisms continues until some external condition influences the balance to the extent that both organisms perish together. In rare cases where the fungus develops both ectotrophically and endotrophically it is questionable whether the associations related are constant. Certain fungi seem to show an affinity for cells of root tissues under every condition of growth; for example, the fungus developing endotrophically within the cells of the roots of Yellow Poplar (Liriodendron Tulipifera) never produce characters of the ectotrophic form such as surface growth on the roots and an extensive system of hyphae between the walls of the cells as in the ectotrophic forms. Other cases of association indicate that the fungi are not always to be found with the same habits for any two species; for example, *Boletus granulatus* forms with White Pine a mycorrhiza showing distinctly different characters from that of *Boletus brevipes* whereas *Boletinus pictis* produces a form of mycorrhiza indistinguishable from that with *Boletus granulatus*. On the other hand, *Scleroderma vulgare* apparently develops a more extensive system of hyphae between the cells of its hosts than any other fungi studied experimentally. These differences in individual species are sufficient to indicate that the morphology of a mycorrhiza is entirely dependent upon the reaction of a specific host tissue to a single invading fungus.

These interrelationships of dissimilar organisms are almost entirely unknown especially where more than one organism is concerned in mycorrhiza formation on the same higher plant species. It is most significant to relate ecological differences found between soil organisms and their action on roots that proof of the mycorrhizal fungus is supplied. Tree roots show generally distinct habits when grown in different locations; that is, those with a deep rooting habit under forest conditions may produce many surface laterals when heavily fertilized or watered in a mineral soil. Planted trees and shrubs are usually grown under conditions where the fungus flora is either modified or entirely changed by soil treatment, but good evidence indicates that even under such conditions the same forms of mycorrhizae are prevalent.

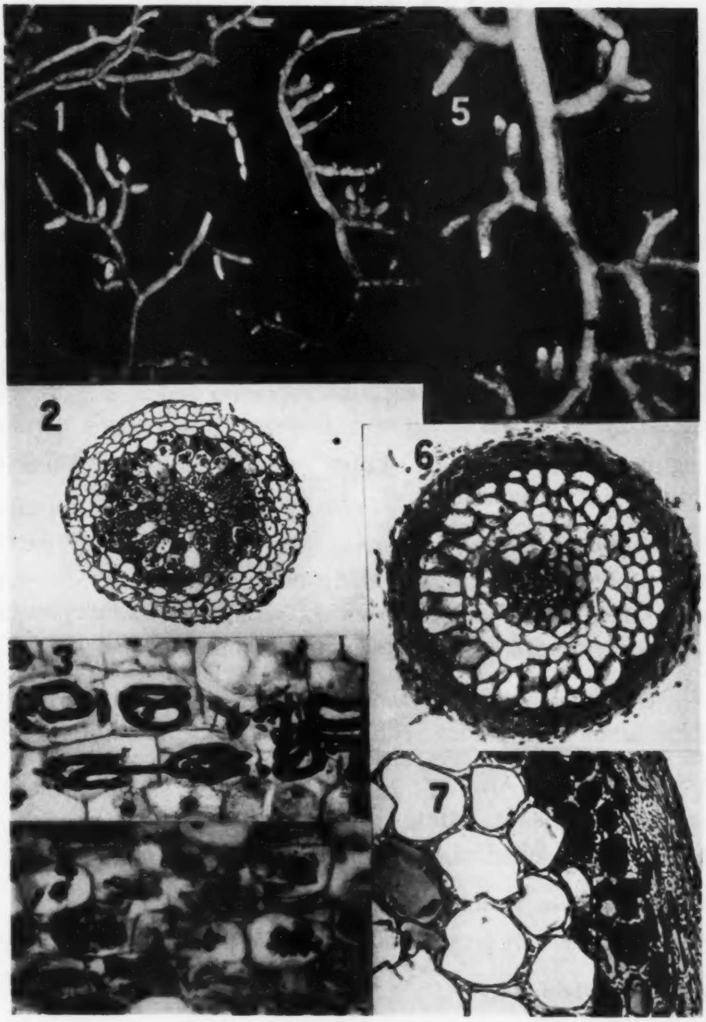
RELATION OF MYCORRHIZAE TO GROWTH

None of the experimental evidence has given proof that mycorrhizae can be strictly beneficial or detrimental under a wide range of conditions. Experiments

conducted over a period of years under single uniform conditions indicate that for a given species of fungus and host the mycorrhizae are strictly non-pathogenic or not so injurious as to produce a condition of disease. Under some conditions they may be beneficial to the growth of the tree or shrub and still others the detrimental effect is equally great. These same fungi with other hosts may influence growth in an opposite manner, for example, *Boletus bicolor* is distinctly detrimental to growth of White Pine under conditions where an adequate supply of mineral nutrients is available, whereas under the same condition *Amanita muscaria* seems to show some beneficial effect. These two species of fungi, when grown with the same host supplied only with forms of nitrogen not directly utilized, benefit growth almost equally under controlled conditions.

The growth factors concerned in a mixed plantings where attempts are made to regulate the growth of more than one tree by a single treatment of the soil can not be expected to favor the fungi on all species equally. A similar situation prevails when shrubs are not handled in a manner which will benefit the growth of associated tree species, and the problem becomes more complex as the number of species increases. It is evident that more knowledge of the growth factors for combinations of mycorrhizal fungi must be obtained before even a beginning can be made in recommending treatments that will be adequate for a large number of trees and shrub species have intermingled roots. The interaction of many dissimilar organisms is too complicated to analyze, but after the limitations in number of fungus species are better known it may be possible to change the soil treatment program to benefit both.

Absorption of mineral nutrients as it occurs through a mycorrhizal mantle has been found influenced by more and different factors than direct absorption through the cortex of a root. The water absorption of trees possessing ectotrophic and endotrophic mycorrhizae may also be changed but, as is the case for mineral absorption, plants for experimental comparison free from mycorrhizae are not available under natural conditions. Mycorrhizae possessing the ectotrophic mantle or sheath covering the roots seem to absorb water from humus under forest conditions as readily as some of the types of mycorrhizae possessing no surface growth of the fungus. When the habitat for either of these same species of tree is changed, the fungi seem to react in other ways, that is, the one concerned in formation of the extotrophic mantle will be increased in growth by reduction in amount of water absorbed whereas that forming the endotrophic mycorrhiza is decreased due to the absorption of more moisture from the cells it occupies within the root. The entire problem of determining where the balance between mycorrhizal fungi and higher plants lies will require many years of intensive study, but the fact remains that it represents one of the most widespread forms of living together or symbiosis in the plant kingdom.



Mycorrhizae of Tulip Poplar *(Liriodendron Tulipifera)* (1). These are endotrophic and appear as swelled root tips. When seen in microscopic cross section (2), the fungus coils occupy large cells near the center of the root but outer cells are infected and the root is not surrounded by a fungus sheath as seen in (6) a cross section of the ectotrophic form (5) of White Pine *(Pinus strobus)*. Enlarged 360 times the development of the endotrophic form inside the cell walls (3) and with clumps of digested fungus threads or hyphae (4) is shown in comparison with the ectotrophic form (7) where the threads or hyphae penetrate only between the cell walls.

WINTER INJURY TO MISCELLANEOUS TREES AND SHRUBS

The following account deals with damage that may be fairly laid to the severe winter conditions of 1933-34, neglecting the results likely to be due to disease, insects, storms and other natural agencies.

The effects of low temperatures were found in certain species to be more severe in old wood than in young wood; in others, the reverse was observed. In some instances, the flower buds were seen to be more susceptible to injury than the vegetative buds; in others, the opposite was seen. Of course, healthy plants, growing in favorable conditions, as a rule, were less liable to damage. Condition of soil, with possible deficiencies, may account for differences in behavior of individuals.

Abelia grandiflora hybrid, M316

Growing in sheltered position. Entire vegetative growth killed to ground. Recovery from root-stock good.

Albizzia julibrissin, Durazz, M783

A healthy specimen of this semi-hardy tree growing in a low, wet position, was completely killed to ground, but from the root-stock healthy growths, 9 to 10 feet high, were developed during the following summer.

With the exception of the following list of deciduous and evergreen species of Barberry, these ornamental shrubs withstood the low temperatures fairly well.

DECIDUOUS

Berberis aggregata, Schneid., M101

Entire growth killed to ground. Recovery fair.

Berberis aggregata var. Prattii, Schneid., M2264

Ninety per cent of growth killed. Recovery fair.

Berberis Vernae hybrid, M108

Entire plant killed to ground. Recovery poor.

Berberis Wilsonae, Hemsl. & Wils., M2627

Entire growth killed to ground. Recovery good.

EVERGREEN

Berberis Gagnepainii, Schneid., M2322

Forty per cent of growth killed by spring. Recovery poor.

Berberis triacanthophora, Fedde., M2326

Twenty-five per cent of growth killed by spring. Recovery poor.

Berberis Sargentianus, Schneid., M2323

Eighty per cent of growth killed by spring. No recovery.

Berberis Veitchii, Schneid., M2324

Fifty per cent of growth killed by spring. No recovery.

Calycanthus occidentalis, Hook & Arn., M1224

Growing on protected hillside with S. E. exposure. Entire growth killed to ground, but recovery from base very good.

Cedrela sinensis, Juss., M764

Large tree growing in low, moist ground; received 10% branch killing, but many suckers surrounding parent plant were uninjured.

Clerodendron trichotomum, Thunb., M74

Growing on low, moist ground. Entire plant killed. The same species growing on steep hillside was killed to ground, but produced strong growth during the following summer.

Davidia involucrata, Baill., M520

The Dove Tree. Large specimen growing in low, moist position. Entire tree killed to ground, partly by a disease infecting the trunk, which destroyed the resistance to sub-zero temperatures. During the following summer, strong, healthy growths were produced from the base, some attaining a height of from six to seven feet.

The following list of species of the May flowering deciduous shrubs, known as Deutzias, all exhibit the same susceptibility to extremely low temperatures. These species were completely killed to the ground, but from the root stock of some of them an abundance of strong, healthy growths gave rise to a new and improved specimen, while other species that were older specimens did not respond so readily to new life.

Deutzia carnea stellata, Rehd., M2299

Did not recover.

Deutzia discolor, Hemsl., M801

Recovery from base good.

Deutzia longifolia, Frane, M1802

Recovery poor.

Deutzia parviflora, Bge., M1800

Fifty per cent of top killed. Recovery good.

Deutzia Vilmorinae, Lemoine, M161

Killed to ground. Recovery good.

Deutzia crenata. D. scabra and varieties

Recovery good.

Deutzia gracilis, Sieb. & Zucc., and *Deutzia rosea,* Rehd., proved to be the hardiest species of the Deutzias. These did not receive the slightest injury to growth or flower buds.

The Diervillas, particularly *Diervilla florida* (Sieb. & Zucc.) varieties, received severe injuries resulting in the destruction of old wood only, indicating low temperatures were not the only cause. Young, vigorous growing branches were resistant to the abnormal climatic conditions. The specimens were grown in both sheltered and exposed positions.

Elaeagnus pungens maculata, Rehd., M328

Growing on protected hillside, S. E. exposure. Ten per cent of branches killed.

Elaeagnus multiflora, Thunb., M1336

Eighty per cent of growth killed. Recovery from base excellent.

Erica vagans, L. (Cornish Heather), M333-334-335

Three large, well-established specimens, growing in well-protected area with southern exposure, were totally destroyed. Young, one-year-old rooted cuttings in slightly protected frame were uninjured.

Fontanesia Fortunei, Carr., M861

Large and old specimen, sheltered from N. and N. W., killed to ground. Recovery at base very poor.

Forsythia suspensa, Vahl., *Forsythia suspensa Fortunei,* Rehd., *Forsythia viridissima,* lindl., *Forsythia intermedia,* Zabel., received severe injuries to flower buds exposed above the snow surface, also tip burn to branches. The mature wood proved to be quite hardy.

Hovenia dulcis, Thunb. (Japanese Raisin Tree), M459

Large, healthy specimen growing on high, well-drained soil in semi-sheltered position. Entire top of tree killed to within 12 feet of the ground. Many healthy branches were produced from the pruned limbs during the following growing season.

Idesia polycarpa, Maxim., M953

Large specimen badly infected by disease and in unhealthy condition was completely killed. Young seedling plants 1 to 2 feet high, growing on high, exposed ground, 50% killed. Recovery good.

Ilex crenata, var., M2363

Killed to within one foot of the ground. Recovery fair.

Ilex crenata, var., M2364

Killed to within one foot of the ground. Recovery good.

Ilex crenata, Thunb., M217

Ninety per cent of growth killed. Recovery fair.

Ilex crenata, var., M218

Killed to within one foot of the ground. Recovery good.

Ilex aquifolium, L. (English Holly), M129-M329

Strong, healthy specimens 15 feet high, growing on a protected hillside sloping to S. E., and surrounded by other trees and shrubs. Entire growth killed to ground and a few weak growths developed from base.

Ilex Pernyi, Franch., M309

Growing in same position near the above. Entire top killed to ground. Recovery very poor.

Ligustrum acuminatum, Koehne, M228

Large single specimen 10% injured. Recovery good.

Ligustrum amurense, Carr., M2243

Single specimen plant, 15 feet high. Entire top killed to ground. Many healthy growths, 5 feet to 6 feet high, produced during the following summer.

Ligustrum ovalifolium, Hassk., M3006

Large single specimen, 20 feet high, 30% of growth killed. Recovery from base very good.

Ligustrum ovalifolium, Hassk.

Californian Privet Hedge growing on steep hillside sloping to N. W., 90% of growth killed. Recovery from base has been good.

Magnolia grandiflora, L., M513

Tree 10 feet high, growing on low, moist ground and protected by a covering of corn fodder. The main trunk represented 80% of the tree, which was killed to the ground. Small side growths at the base were uninjured. No appreciable recovery.

Magnolia grandiflora, L., M600

Specimen tree 18 feet high, growing on a steep, dry bank and protected from N. and N. W. by a building, and from the south by woods. Received no winter protection of corn fodder. This evergreen species showed only abnormal browning and shedding of leaves. Recovery was rapid and permanent.

Mahonia japonica, D. C., M1212

Entire plant killed to ground.

Nandina domestica, Thunb.

Five specimens of this shrub, which is of doubtful hardiness, growing on a sheltered hillside and provided with corn fodder protection, received an average of 50% growth killed. The following summer's growth made up the 50% loss.

Poncirus trifoliata, Raf.

A number of large specimen plants of the Hardy Orange, growing on a sheltered hillside, received 90% killing of all branches. After pruning, a few branches were produced from 1" caliber stems, but owing to frost cracks, internal injuries, and disease infection, these plants were destroyed. Two-inch caliber stems did not develop new growth.

Prunus subhirtella pendula, Tanaka, M1071

Large grafted tree growing on exposed windswept hill—lost 5% and 75% of flower buds. Another plant of the same species growing nearby had 90% damage to flower buds, but no growth injury. Still another specimen of the above, growing in a protected and lower elevation, received 20% flower bud damage only.

Pyracantha coccinea Lalandii, Dipp., M559

Large and old specimen of the Firethorn, growing on slightly elevated ground, was killed entirely. A younger specimen of the above species, growing nearby, received a branch tip burn only, with no permanent injury resulting.

Rhododendron

Large-leaf, hardy hybrids growing in low, moist ground, exhibited only normal winter injury.

Rhododendron obtusum Kurume hybrids, growing in the same position as the above, were permanently destroyed.

Rhododendron obtusum amoenum, Rehd.

Received 70% growth injury.

Rhododendron obtusum, var. Hinodegiri

Also in the low position. Was 80% killed, while the same variety, growing at a higher elevation and in a windswept location, suffered 10% loss of vegetative growth.

It is also interesting to note that *Rhododendron yedoense,* Maxim., and the variety poukhanense, Nakai, growing in this low, moist position, did not exhibit any injurious effects from the abnormal, sub-zero temperatures.

Stapylea pinnata, L., M158

Entire plant killed to ground. A few weak growths developed during the following summer. Another specimen of the same species, with same degree of injury, produced growths 6 to 7 feet long from the base.

Styrax obassia, Sieb & Zucc., M476

A large specimen growing in sheltered position—had 80% of growth killed. Recovery fair from trunk only.

Styrax japonica, Sieb. & Zucc., M2097

Killed to ground by disease and extreme cold; weak growths from base, but no permanent recovery.

Viburnum betulifolium, Batel, M16

Growing on exposed slight elevation. Entire growth killed to ground. Recovery from base fair.

Viburnum hupehense, Rehd., M5

Same position and injury. Recovery from base good.

Viburnum opulus nana, M526

Dwarf compact plant—90% of growth killed. Recovery good.

Viburnum scabrellum, Chapm.

One large and one small specimen. Both were injured 20%, and recovery was good.

Viburnum tomentosum sterile, K. Koch.

Killed to ground, but during the following summer new growths 3 feet high developed.

Viburnum rhytidophyllum, Hemsl., M448

Large, healthy specimen, 15 feet high, 15 feet spread, growing on protected hillside having S. and S. E. exposure. A 50% killing of the branches resulted in weak growths from the upper growth the following summer, but from the base new growths developed to a height of 6 feet. This specimen would have recovered had there been a more favorable season the following year.

JAMES LAMBERT.

DEATH OF COLONEL ROBERT GLENDINNING

COLONEL ROBERT GLENDINNING, a member of the Advisory Board of Managers, died on April 19, 1936, at the age of sixty-nine years.

His life was marked by a successful business career, to which was added one of distinguished public service. He served in the cavalry through the Spanish-American War. He founded the Aviation School at Essington in 1917, and served as Lieutenant-Colonel in the United States Air Service of the American Expeditionary Force in the Great War. For many years he was a member of the Fairmount Park Commission.

GARDEN NEWS

With the coming of spring, the Arboretum became increasingly a place of interest. Fourteen groups from ten educational institutions came as classes to study the plant life to be seen here.

Garden clubs and other outing groups in similar numbers have enjoyed the various flowering groups as the season has passed.

Again the Arboretum has been the meeting place of larger groups. On May 9th, the May Frolic of the women students of the University of Pennsylvania and the Alumnae Luncheon brought in about two thousand people.

The spring meeting of the Society of the Sigma Xi, the honorary scientific society of the University of Pennsylvania, was held at the Arboretum. A short program, descriptive of the activities of the place, and a buffet supper, brought an attendance of about three hundred persons.

The Liberal Arts Board of the University of Pennsylvania met here on May 25th.

The Faculty Tea Club of the University of Pennsylvania met at the Arboretum on May 26th, approximately six hundred members and guests being present.

The women of the Senior Class of the University of Pennsylvania held Class Day exercises and a garden party at the Arboretum on June 9th.

The Arboretum has been open to the public from one to five o'clock on Wednesdays, Thursdays and Saturdays, with a large number of visitors.

May 30th and 31st, Saturday and Sunday, were Spring Open Days the grounds being open from nine to five o'clock, with large numbers being present.

ACKNOWLEDGMENTS

The Arboretum acknowledges with thanks the addition to its library of thirty-one volumes of the Contributions from the National Herbarium, presented by the National Museum.

Henry A. Dreer, Inc., of Philadelphia, has favored the Arboretum, and added to the interest of the rose garden by the gift of fifty plants each of "Carrie Jacobs Bond" and of "Little Beauty" Roses.

The New York Botanical Garden has added valuable material to the Herbarium of the Arboretum by presenting to it 716 sheets of woody species collected by Dr. Camillo Schneider in the Arnold Arboretum in 1915 and 1918.